

# IN SEARCH *of an* OASIS

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## OPPORTUNITY IN THE MIDDLE EAST

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Across the Middle East, people contend with heat, dust, lack of rainfall, and a harsh geography. In this century, industrial development, political upheaval, and war have left a legacy of environmental and health problems. Scarce arable land is being lost to desertification. Fresh water is diverted, misused, and polluted with hazardous wastes, sewage, and agricultural and other chemicals. Coastal zones are polluted with oil, threatening pristine coral reefs, wild fowl, and fishing areas. Unprecedented urbanization and migration of traditionally rural peoples and resettlement of political refugees and foreign workers strain city services.

Yet there is reason for optimism in the Middle East. Peace in the region is in sight, bringing an opportunity to stop the rapid environmental decline. Technology is available to assess the degradation, and the impact of environmental conditions on human health can be quantified.

Scientists, government officials, academics, and health professionals across the region know that environmental decline leads to human disease and disability and weakens the economy. They recognize local problems and look forward to changes in government policies that assign priority to public health, environmental protection, and cooperation between countries. Regional collaborative pilot projects to reduce exposure to agricultural chemicals and to conserve and better manage water resources are now beginning under the aegis of the Middle East peace process. These projects were not possible before the peace accords were signed 30 months ago.

The region which makes up the Middle East includes Jordan, Israel, the Palestine Autonomous Territories, Lebanon, Syria,

and Iraq, as well as Egypt, on the northeast corner of Africa, and Iran, to the east. In addition, on the Arabian Peninsula to the southwest are Kuwait, Saudi Arabia, Qatar, the United Arab Emirates, Oman, Yemen, and the island nation of Bahrain.

Throughout human history, this land bridge connecting the Nile River Valley in central Egypt with ancient Mesopotamia (now Iraq) in the valley between the Tigris and Euphrates Rivers has been the focus of religious and political conflicts. This is an area of rapid development of natural resources, trade, and commercial fortunes, and a source of major scientific, engineering, and cultural advances. Today there are striking examples in this area of both success in overcoming the forces of nature and failure in protecting the environment, natural resources, and human health.

### Dust, Heat, and Water

Desert sands and dusts, blown for much of the year by relentless winds, combine with temperatures ranging from below zero to 50°C across the Middle East. Regionally, only 5% of all land is arable. This scarce farm land is being lost to desertification. Every country in the region reports a decline in the amount of water available for drinking and irrigation. On the Arabian Peninsula, intense heat with high humidity in coastal areas, along with blowing dust and sand and lack of natural fresh water are the rule. Across the peninsula, oil production and refining and vast construction projects add dust and hydrocarbon mists to create dangerously poor air quality levels in the cities.

Egypt presents a typical example of the impacts of desertification and climate on

agriculture. Only 3% of Egypt's one million square kilometers (km<sup>2</sup>) is arable. A narrow band of farm land stretches 1000 km along the Nile River from south of Aswan north through Cairo to Alexandria on the Mediterranean Sea. It is slowly being lost as prevailing winds move the Sahara Desert onto some of the most fertile soil in the world. The Sahara extends almost 5000 km across North Africa and encompasses all of Egypt including much of the Sinai Peninsula.

To the west of the Nile, the Great Sand Sea—45,000 km<sup>2</sup> of massive sand dunes—undulates under searing heat and bone-chilling cold. Discovery of a large aquifer near the Farafrin oasis in the middle of the Great Sand Sea in the early 1970s raised hope of increasing the amount of arable land in Egypt. The intention was to create a new city in the midst of a center of agricultural production. Plans to relocate up to a million people to establish such a center have not met expectations. The government offered relocation allowances, financial aid, technical assistance, and cheap land, but farmers were reluctant to move to such a remote area and risk desert life. Those few who have attempted to farm there find that crop production in irrigated desert soils does not support their costs.

Egyptian agriculture is further threatened by increasing soil salination along the Nile south of the Aswan Dam and urban spread into the farm lands on the Nile River around the two major cities of Cairo and Alexandria.

According to Bakir Oteifa, a senior advisor to the Minister of Agriculture in Cairo, introduction of modern agricultural methods that increase per acre production



and use innovative engineering projects to preserve water for irrigation have been offsetting loss of arable land to desertification and soil salination. Egypt has been a pioneer in water conservation. In the Nile delta around Alexandria, billions of cubic meters of irrigation runoff each year are reclaimed from the Nile before it flows into the Mediterranean Sea. Egypt annually recycles more water than is used in agriculture by Jordan or Israel, countries with similar levels of agriculture production.

In the Middle East outside Egypt, human behavior has hastened desertification and in some instances dramatically changed the landscape. In ancient times, much of north Jordan and Israel had sufficient rainfall and climate to support an agricultural economy. Mountains and valleys were green with forests. These areas were deforested by the Romans and Ottomans. As a result, annual rainfall decreased and the region became a wasteland. Over the past 30 years, Jordan and Israel have been reforesting. While changes in climate have not yet been seen, with irrigation projects and land reclamation, both Jordan and Israel have become exporters of fruits and vegetables to European markets.

Syria, Iraq, and Iran have large regions with moderate climate, adequate rainfall, and arable land, but water is becoming scarce and arable land is being lost. This is the result of recent human activity on a grand scale. Over the past decade, the government of Turkey completed the Ataturk Dam project across the Euphrates River to provide water for agriculture to the arid Harran Plain north of its border with Syria. Filling vast reservoirs with billions of cubic meters of water behind the dam created water shortages downstream in Syria, which is dependent on a constant flow from the Euphrates for drinking water, irrigation, and electric power.

In Syria, fresh water is critical to the economy and to human health. Syria also built a dam on the Euphrates at Tabqa to supply electricity and a continued source of water. But low water behind the dam resulting from completion of the Ataturk project in Turkey caused routine power cutoffs and exacerbated water shortages resulting from recent droughts. In Damascus, where the population growth rate of more than 5% per year is among the highest in the Middle East, the water distribution system is antiquated and failing. It is also contaminated with sewage and industrial wastes. Outbreaks of gastrointestinal disease have been traced to the use of untreated sewer waters for irrigation during water shortages. According to U.S. State Department assessments of Syria for

1994, 30% of land is arable, 30% of the work force is in agriculture, and agriculture makes up 30% of the gross national product. Loss of water for irrigation could be economically catastrophic to a nation still at war with Israel and no longer receiving aid from the former Soviet Union.

### Reclaiming the Desert

There are areas in the Middle East where the desert has been transformed into productive agricultural zones. But these successes may have produced serious long-term consequences for the environment and human health.

In Saudi Arabia, financial wealth and technology have combined to turn desert into wheat fields. Geographically the largest country in the Middle East, Saudi Arabia covers 2 million km<sup>2</sup> on the Arabian Peninsula between the Red Sea and the Persian Gulf. The Saudis built 22 water desalination plants along both coasts. These plants generate about one-third of all the desalinated water produced worldwide.

Water from the desalination plant at Al Jubayl on the northern Persian Gulf is pumped to Riyadh and further inland to irrigate wheat fields extending 150 km northwest. Saudi Arabia is the seventh largest wheat supplier in the world. Other agricultural products include tomatoes, melons, barley, dates, citrus fruits, mutton, chicken, eggs, and milk. The annual production meets the basic food needs of the country's 19 million people.

In addition to desalination, the Saudis have drilled into their "fossil aquifers" to provide an additional source of fresh water. These very deep aquifers were formed millions of years ago and are common in North Africa and the Middle East. The water trapped in fossil aquifers does not regenerate. Only Saudi Arabia has the fiscal resources needed to drill and pump

them. Some hydrogeologists are concerned that depleting these aquifers may cause surface collapses or other unpredictable environmental consequences. The Saudis estimate that the fossil aquifers will not be depleted for at least 25 years and may last for more than a century. In the meantime, they will continue to use the resource.

Israel, on the other hand, lacks the oil that generates the Saudi fortunes, yet it has had great success in establishing a flourishing agricultural economy in a once barren desert land. This success has come at a price to the environment though, and there is emerging evidence that water supplies to the cities are contaminated with agricultural chemicals.

Since its creation in 1948, Israel has applied emerging agricultural science and technology with sheer determination to achieve the productivity to feed a nation of 4.5 million people. Only 17% of Israel is arable. The Negev Desert covers 60% of the south. The northern region is mountainous. Much of the arable part of the Jordan River north of the Dead Sea is in the West Bank Territory, which has been politically unsettled since the partition of Palestine to create Israel. To be agriculturally self-sufficient, Israel has to maximize food production from the northern part of the Jordan Valley and claim a significant part of the Negev for growing crops. In the 1960s, the National Water Carrier project was completed. The project channels water from the Sea of Galilee to the Negev. This project created outrage in Jordan and among the Palestinians in the West Bank area because it diverted water from the Jordan River downstream, reducing the only source of irrigation to those farms. In addition, the Israelis control the flow of water from the aquifer under the southern coastal plain, which is the only natural source of fresh water to the Palestine Gaza Strip territory. The Israelis used these water

### Availability of water by region

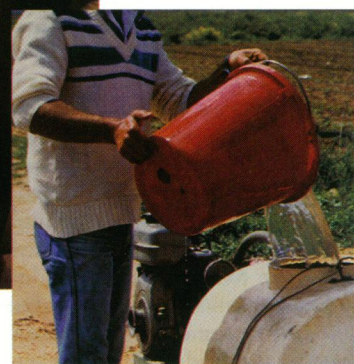
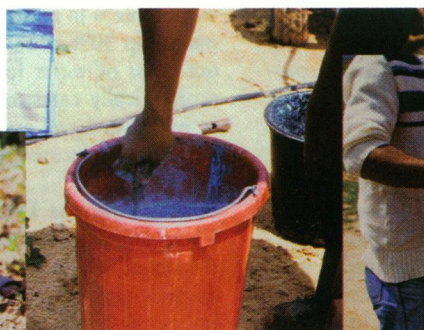
	Annual internal renewable water resources		Population in countries with scarce annual per capita resources (%)	
	Total (× 1,000 m <sup>3</sup> )	Per capita (× 1,000 m <sup>3</sup> )	Less than 1,000 m <sup>3</sup>	1,000– 2,000 m <sup>3</sup>
Sub-Saharan Africa	3.8	7.1	8.0	16.0
East Asia and the Pacific	9.3	5.3	<1.0	6.0
South Asia	4.9	4.2	0.0	0.0
Eastern Europe and former U.S.S.R.	4.7	11.4	3.0	19.0
Other Europe	2.0	4.6	6.0	15.0
Middle East and North Africa	0.3	1.0	53.0	18.0
Latin America and the Caribbean	10.6	23.9	<1.0	4.0
Canada and the United States	5.4	19.4	0.0	0.0
World	40.9	7.7	4.0	8.0

Source: The World Bank, 1992





**A question of care.** Most agricultural workers, including children, in the Middle East face an appalling lack of protection from the dangers of pesticide exposure.



resources to irrigate the famous communal agricultural operations, the kibbutzim.

There are about 250 kibbutzim, the first of which was founded in 1908. Today only about 3% of Israelis are engaged in agriculture. These kibbutzim (and moshavs, where families live together and usually farm their own plots of land) are highly productive, self-sufficient, and profitable agricultural operations. Many include food processing and packaging facilities and laboratories to identify insect and fungal pests and pesticide tolerance. They employ significant numbers of migrant farm workers from the Palestine territories as well as volunteer guest workers from around the world who come to experience life on the kibbutzim.

Workers on the kibbutzim labor under great physical stress and occupational hazards. The Jordan River valley is below sea level and temperatures of 50°C are not uncommon during the growing season, which makes use of protective gear during pesticide applications difficult and sometimes impossible.

There is a constant battle with insect

pests. Almost every chemical pesticide, fungicide, and rodenticide developed since World War II has been heavily used in Israel. Surface and aerial pesticide applications and associated leaching and drift into living areas and water supplies was common up until the 1990s. Recently, agricultural chemical use has been limited and carefully controlled, but decades of overuse have left a legacy of contamination of scarce water resources and disposal of containers and unused chemicals remains a problem.

The use of greenhouses and screen houses for growing fruits and vegetables is a significant innovation that is now common practice in Jordan, Israel, Egypt, and the Palestine West Bank territory. These keep insects and other pests away from the crops and help control moisture content of soils. Greenhouses and screen houses have changed exposure patterns of agricultural workers to pesticides and fungicides. When these chemicals are used in field settings, dermal exposures to the feet and lower legs are most common. Protective clothes can prevent uptake. In greenhouses and screen houses, dermal exposures are decreased, but inhalation exposures are intensified.

Inhalation is generally significantly more hazardous than dermal exposure. Protective gear to prevent inhalation is expensive, cumbersome, and uncomfortably hot.

In the Palestine West Bank territory, an aggressive agricultural education extension program has been implemented by the Arab Bir Zeit University. As a result, Arab farmers are producing oranges, mangoes, dates, avocados, and other crops using methods almost identical to the those in the kibbutzim. Sameer Abu-El-Haj of the Bir Zeit University Center for Environmental and Occupational Health has established a pesticide training program for Arab farmers in the West Bank. His program is a model for similar efforts throughout the Jordan Valley.

One clear benefit of peace in this region of the Middle East will be increased cooperation in agriculture by Jordan, Israel, and the Palestine territories. If water resources are shared more equitably, continued advances in agricultural technologies are implemented, and there is collaboration in planning, restoration of the Jordan River Valley as a food basket for the Middle Eastern region is clearly within reach.

#### Arable land by region

	Total area (km <sup>2</sup> )	Arable land (km <sup>2</sup> )	Arable land (%)
Bahrain	620	12	2
Egypt	1,001,450	30,043	3
Jordan	89,213	3,568	4
Iran	1,648,000	131,840	8
Iraq	437,072	52,448	12
Israel	20,770	3,530	17
Kuwait	17,820	0	0
Lebanon	10,400	2,040	20
Oman	11,000	220	>2
Qatar	212,460	0	0
Saudi Arabi	1,960,582	19,605	1
Syria	185,180	51,850	28
United Arab Emirates	75,581	0	0
Yemen	527,970	31,678	6

(Data are not available for the Palestine Autonomous Territories.) Source: U.S. Department of State Country Profiles, 1994.

#### Urbanization

Urban environmental problems can be found throughout the Middle East. Tel Aviv and Jerusalem are choked with traffic, which combines with industrial emissions to cause serious air pollution problems. Drinking water in Damascus is polluted with untreated sewage and wastes from petroleum refining. Destruction of the water and sewer treatment systems in Baghdad and Basra during the Persian Gulf War exacerbated air pollution and existing scarcity of potable water. Cement dust from extensive construction projects and an exponential increase in vehicle traffic add to desert dusts that plague many cities on the Arabian Peninsula.



The press of the encroaching desert on traditionally agricultural areas and the lure of a better quality of life have drawn many traditionally rural Middle Easterners to urban centers in their own countries and stimulated the migration of others to more affluent nations of the region to become unskilled laborers. Migration to the cities has put great stress on the urban environment.

Nowhere is the situation more acute than in Cairo. Egypt's population of 66 million is the second largest in the Middle East. Only Iran is larger with about a million more inhabitants. It is estimated that one of three Egyptians lives in Cairo.

Modern Cairo arose after the great Muslim conquests of the sixth century. After assuring domination of Egypt and the rest of the Middle East, the Islamic conquerors built a mosque and established their religious roots at a crossing point on the Nile River on a traditional trade route. Growing up around the mosque, Cairo became established as the Islamic capital of Egypt. While it prospered as a center of religion, culture, education, trade, and commerce, Cairo also suffered from wars, famines, and plagues. It was not until the 1900s that sewers were installed and enough fresh water became available to bring cholera, plague, dysentery, and other communicable disease under control. Only then did the birth rate exceed the death rate and the population increase. In the late 1800s the population was about 500,000 and by 1930 it had grown to 1 million.

Today, the influx of poor people from the countryside has swollen the population to 18 million. Urban services can no longer meet the basic needs of shelter, food, and sanitation. The poor settle into every vacant space, including rooftops and alleyways. Even the large tombs and mausoleums built by the Muslims have been turned into crowded communities of poor refugees. These communities lack basic sanitation services, water, sewers, and health care.

Dense traffic clogs the streets from daybreak to the early hours of the morning. The majority of vehicles are old, inefficient, and fueled by leaded gasoline or diesel fuel. From May to November, daytime temperatures climb to 38°C under a relentless sun and there is little wind. Desert dusts permeate the city. Urban air pollution from vehicle exhaust, burning of wastes, dusts, and other particulates creates a dense smog over the city that accumulates until infrequent winds drive it south down the Nile or west into the Sinai.

## Population

	Population (× 1,000)	Birth rate (per 1,000)	Migration (per 1,000)	Growth (%)
Bahrain	603	26.6	+6.8	2.96
Egypt	66,538	28.7	-0.4	1.95
Jordan	4,099	37.8	+0.5	3.50
Iran	67,885	42.4	0.0	3.46
Iraq	20,631	44.1	+0.4	3.73
Israel	5,162	20.5	+8.0	2.22
Kuwait	1,914	29.4	+25.4	5.24
Lebanon	369	27.9	-1.5	1.98
Oman	1,760	40.4	0.0	3.46
Qatar	526	18.8	+10.1	2.56
Saudi Arabia	18,787	38.3	0.0	3.24
Syria	15,444	43.7	0.0	3.74
United Arab Emirates	2,924	27.7	+23.3	4.79
Yemen	11,476	50.7	-2.4	3.33

(Data are not available for the Palestine Autonomous Territories.) Source: U.S. Department of State Country Profiles, 1994.

## The Ravages of War

Three generations of Palestinian refugees are packed into camps on the outskirts of Amman, Jordan. Some have awaited permanent resettlement since the partition of Palestine in 1948. These refugee camps were never planned as permanent settlements and the government of Jordan did not provide housing, water and sewer facilities, sanitation, or health services needed by communities of tens of thousands of people for a 50-year period. No data are available on the health status of the

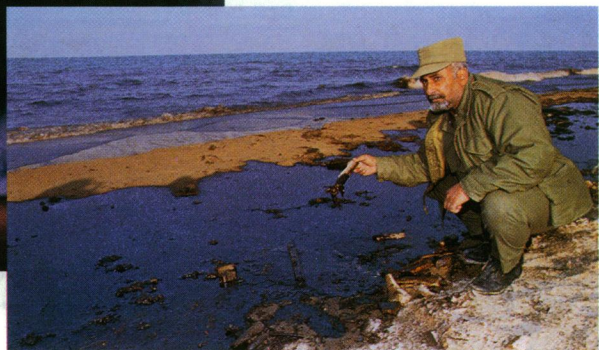
refugees, but overcrowding and lack of essential services are always associated with increased morbidity and mortality.

In Iraq, years of war have created a human health disaster. According to assessments by the United Nations, one-fifth of the population is in "severe nutritional distress" in 1996 and the majority of those who are suffering are women and children. A significant number of these women are pregnant or nursing mothers. Iraq is water-rich by regional standards, but has not conserved fresh water and has not expanded

its resources at the same rate as its neighbors. It uses water from the Euphrates River for irrigation and the Ataturk Dam project has affected this source. As a consequence, its water problems are critical and agricultural production cannot keep pace with the nation's need for food. War has consumed a major portion of Iraq's oil revenues. Since the Persian Gulf War, Iraq has not yielded to sanctions by the United Nations that permit oil to be traded for food. As a consequence, the overuse of water from the Euphrates River for irrigation and substandard drainage practices have resulted in salination



**Crude out of control.** The bounty of the Persian Gulf's oil became an environmental disaster of wartime spills and fires.





of once fertile soils in Iraq. Overuse of fertilizer and pesticides has contaminated the fresh water that remains. The damage is not irreparable but extensive soil revitalization and irrigation programs are needed. This crisis competes with and contributes to the plight of the cities that were badly damaged during the Persian Gulf War. Solutions to the environmental crisis are impossible in Iraq with its economy in shambles and international trade sanctions in place.

The Persian Gulf War began when Iraq invaded Kuwait on 2 August 1990. On 12 January 1991, air strikes averaging 2000 sorties a day against targets in Iraq began. The ground assault was launched from Saudi Arabia on February 23. When the firing ceased on February 28, the Iraqis had been routed and Kuwait and Iraq were devastated. Estimates of deaths from the conflict range from 100,000 to 200,000. Kuwait City was in shambles, and the infrastructure in Iraq was destroyed. This brief war was unique in at least two respects. It was the first to be televised live via satellite to a worldwide audience and it had an awesomely destructive environmental impact.

As the Iraqis fled, they set fire to the wells and storage tank farms in six Kuwait oil fields. (Iraqi forces were entrenched in and around these fields and the petroleum loading terminals, so it is probable that air strikes against these targets by the coalition forces ignited some fires.) Five million barrels of oil (260 million gallons) a day burned out of control from 500 wells. An estimated half million tons of thick black smoke darkened the sky. In late March of 1991, dozens of wells were still on fire. Smoke and soot rose thousands of feet and drifted with the wind. Heavy soot particles rained on Kuwait, Saudi Arabia, Iraq, and Iran. Lighter particles fell on the mountain snows 2000 km east in Pakistan. In the weeks after the war, concentrations of par-

ticulates in samples taken above the Rocky Mountains in the United States were 100 times background levels. In August, astronauts reported seeing black haze in the stratosphere.

The most dramatic impact of soot and gases was localized in Kuwait, Saudi Arabia, Iraq, Iran, and Turkey. In the immediate area, civilians of all ages, military service men and women, and the huge cadre of civilian advisors were covered with soot and inhaled the smoke and fumes. Everything they touched or ate was contaminated. Crops and livestock were heavily polluted.

Crude estimates of pollutants were made by a Gulf Emergency Response Team convened by the United States. They reported that the fires were emitting 100,000 tons of particulate, 50,000 tons of sulfur, and 850,000 tons of carbon dioxide per day.

While there were anecdotal reports of acute respiratory and dermal effects from individuals and health providers in Kuwait in the weeks and months after the cease fire, these reports were difficult to quantify in this hectic and tense period. No systematic follow-up of health effects attributed to the war has been done in the area. In the years after the war, 40,000 veterans from the United States have reported symptoms they have related to their service in the gulf. These include chronic headache, nausea, anxiety, depression, joint pain, reproductive dysfunction, and others. In 1994, the U.S. Department of Defense completed a study of more than 10,000 veterans and concluded that no clear picture of a unique illness related to service in the Persian Gulf could be identified. An expert panel of the National Academy of Sciences Institute of Medicine issued a cautious report lending credence to the veteran's complaints. In August 1995, a presidential commission on the gulf war syndrome held its first meetings.

Its report is due in December 1996.

Environmental monitoring, exposure assessment, and surveillance for diseases and symptoms were not possible in the chaotic weeks after the cease fire. Rigorous longer term assessments and follow-up have been hindered by lack of specific data on exposures and the absence of a disease or condition specifically related to the war.

The Persian Gulf War produced the world's largest oil spill to date. The oil under the Burgan field, the largest in Kuwait, is under natural pressure and continued to flow into the desert sands creating a vast lake of oil. From 35 to 150 million barrels of unburned oil accumulated on Kuwait's desert. For about 500 km s along its west coast southward past Kuwait to Saudi Arabia, 8 million barrels of oil covered the shoreline. Over 1500 km<sup>2</sup> of water were covered with crude oil. Half of this was lost from tankers caught in the warfare and the rest spilled from storage tanks and pipelines emptied by the Iraqis.

The western shore of the Persian Gulf is shallow. It is a migratory pathway for water fowl, a source of fish for local consumption, and has coral reefs. The gulf opens at the Straits of Hormuz into the Indian Ocean. The strait is less than 70 km across, so natural flushing of the gulf takes years.

Petroleum products from all the oil-producing states in the Persian gulf are shipped to markets from terminals through the Straits of Hormuz. An annual average of at least 200,000 barrels of oil and oil products spill into the gulf. It is one of the most polluted bodies of water in the world. The millions of barrels spilled during the Persian Gulf War have settled on the bottom to join the millions spilled over the last four decades. Much of the shoreline is covered with a crust of dried oil. The Kuwait oil fields are back in production and millions of barrels of oil have become a part of the surrounding desert.



**Hazardous trash.** Waste disposal in many Middle Eastern countries means finding the closest unused container or piece of ground.







**Signs of the times.** Signs of progress include open borders, integrated pest management, sustainable water use, and international cooperation.



## A View to the Future

Throughout much of the Middle East living standards have improved, particularly for the upper and middle class, as a result of oil revenues, development of other natural resources, industrialization, and economic and technical aid from Asia, the European Community, and North America. Peace has come to most of the region. Syria and Lebanon appear to be about to join the countries that have finally reached accord with Israel. It is conceivable that Iraq and Iran will rejoin the world community before the end of the century.

For most of the current century in the Middle East, the environment and public health have been given much lower priority than economic development and military strength. Regional leaders have now agreed to work to change these priorities in the Middle East.

The working group on the Multi-national Middle East Peace Process, made up of senior foreign ministry officers from all the nations that signed the peace accords in September of 1993, have endorsed the concept for four cooperative programs to reduce human suffering. These include arms control, refugee resettlement, water resources management and distribution, and environmental protection. These cooperative programs are to be planned and implemented by technical experts from Egypt, Israel, Jordan, and the Palestine Autonomous Territories. The U.S. government is providing advice, assistance, and funding for the planning effort.

Only one environmental program has been approved so far. It is aimed at reducing human exposure and health effects from misuse of agricultural chemicals. Program participants include government and university-based experts in environmental and occupational medicine and public health, toxicology, ecology, and agricultural sciences. They are being assisted by staff from the National Institute of

Environmental Health Sciences and the U.S. Department of Agriculture. The technical experts first met in December 1994. They have since developed a work plan and set priorities for cooperative projects.

A system of communications and technical information management has been established for the participants, which has been a difficult task. Telecommunications and travel among countries and territories in the Middle East have been carefully restricted until recently and problems still exist. This project offered the first opportunity for potential colleagues with similar interests to meet and visit their neighboring countries and institutions.

Now that the planning phase is complete and an infrastructure for collaboration is in place, several pilot projects will begin in 1996. These include an impact evaluation of all local health education efforts in worker safety for farmers, farm families, and other agricultural workers, and collection and sharing of data on pesticide use and registration practice, environmental monitoring, exposure assessment, and residue analyses for agricultural chemicals. At the same time, two demonstration projects in integrated pest management (IPM) will be initiated. The health effects prevention projects and the IPM projects will be linked so that all necessary scientific disciplines may be included in the regional collaborations.

Longer-term projects include development and evaluation of routes and patterns of human exposure, exposure assessment using biological markers, development and evaluation of expanded health education and worker safety training, and new training opportunities for young scientists interested in environmental health and toxicology.

Although this program is narrowly focused on the safe use of agricultural chemicals, it has already stimulated informal collaborative studies of technical

experts in the region. A small effort to test children for blood lead concentrations in Cairo, Amman, and Jerusalem has begun. The intention is to gather preliminary data on the impact of urban pollution on human health. Discussions are taking place on how to follow up on the effects of exposures to the oil fire smoke and soot in Kuwait, Iraq, and Iran. And in Gaza, data on cancer incidence and mortality and levels of chemical contaminants in drinking water are being collected to provide baseline information for longitudinal studies of refugees who have returned to Gaza and of long-term residents.

All of these formal and informal collaborations will require significant funding over many years. Redistribution of funds from military use to these efforts is possible in the Middle East, but additional aid and assistance will be required from developed countries dependent on Middle East oil and from industries that profit from peace in the region.

If regional tensions are eased by the year 2000, the Middle East has the human resources and financial strength to return to a state of world leadership. The next century could also find the Middle East to be among the healthiest and most environmentally sound regions of the world.

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